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CONTENTS

INTRODUCTION.—The Western Navajo Reservation, lying east of the Marble and Glen canyons of the Colorado and south of the San Juan River (Fig. 1), is a virgin field for geographic research. Its surface is wonderfully molded by a maze of profound canyons cut in brilliantly colored rocks, and upon its myriad mesas the winds of an arid climate have left their characteristic impress. Areas of bare rock and areas scantily clothed by specialized plant forms are interrupted at Navajo Mountain by a luxuriant garden of flowers, shrubs, and trees which would not be out of place in a New England landscape. Within this region are the Hopis, a remnant of an ancient race, the fundamental lines of whose history have yet to be written. In the midst of the ruined villages the vigorous and promising Navajos carry out their nomadic lives.

As yet the natural environment of Navajo and Hopi has been modified but little by the coming of the white man. Three widely separated trading-posts located near the edge of Black Mesa include all the white inhabitants outside the Indian Agency, and the total white population within an area of about 7,000 square miles is 63. Surrounding this handful of officials, traders, and missionaries, 6,550 Indians of three distinct races conduct their affairs with little regard to the wishes of a superior race. The only settlement of note within this undeveloped tract is on the Oasis of Tuba—a settlement with an uninterrupted history since times long antedating the dawn of American history.

The pioneer route to Tuba from Salt Lake City crossed the Colorado River at Lee's Ferry, while the route from the south followed the desert floor of the Little Colorado Valley. By the construction of the Santa Fe Railroad a better approach was afforded via Flagstaff, and the 80-mile

stretch of grass-dotted flat and bare desert between the railroad and Tuba has become the most used north-south route across northern Arizona. The road is rough and water is obtainable during the dry season at only one place; but in comparison with other lines of access, this route is highly satisfactory. The construction (1912) by the government of a suspension

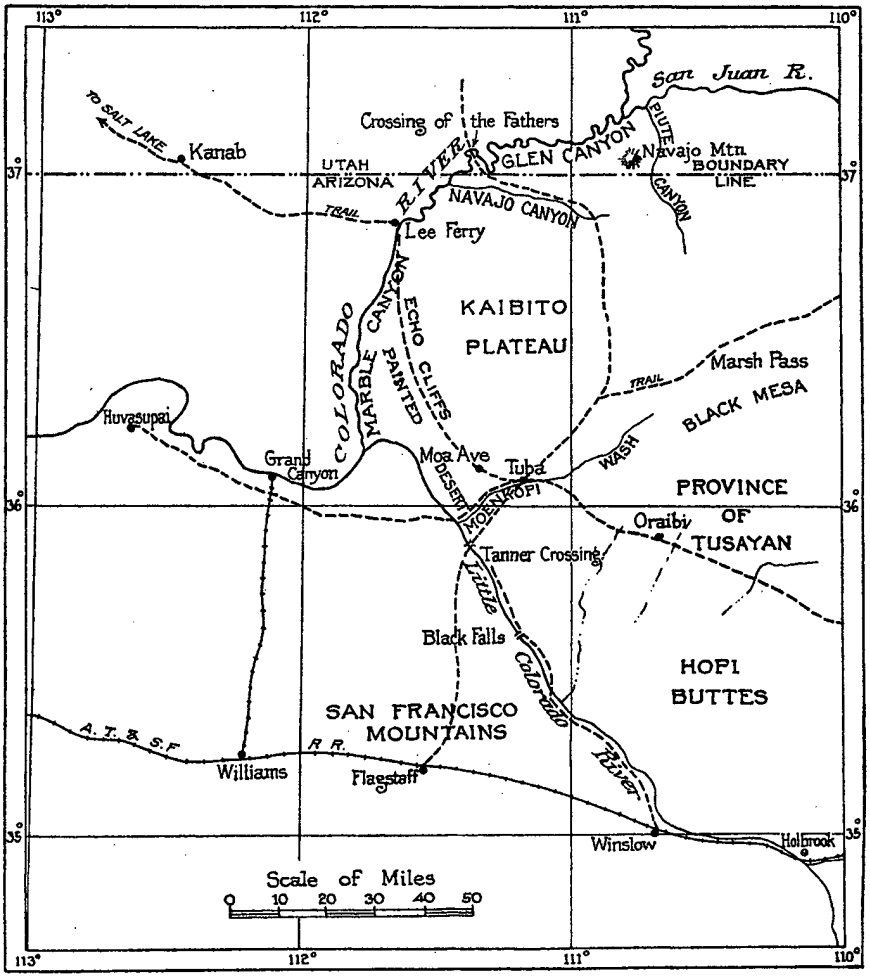

FIG. 1.—Map of a portion of Northern Arizona and Southern Utah, showing the geographic setting of Tuba Oasis. The trails, indicated by broken lines, are centuries old and are still utilized by the Indians and in part also by the Whites.

bridge across the Little Colorado has eliminated Tanner's Crossing, whose quicksands have claimed their toll of goods and lives since the days of the first pioneer. Traveling in an automobile, one may pass through the forests of the San Francisco Mountains, down the long, bare slopes of San Francisco Plateau, cross the canyon of the Little Colorado high above

its bed, and make his way across the heated floor of the Painted Desert to the orchards and groves of Tuba. By this method of travel scant appreciation is gained of the hardships and dangers involved in attacking the desert—the task of the Indians for centuries and of the whites for the last fifty years.

Tuba is perched on the edge of Kaibito Plateau, a windswept, dune-dotted tableland overlooking the beautiful but inhospitable Painted Desert (Plates I*a* and III*b*). The south and west edges of the Oasis are defined sharply by the walls of the Moenkopi Canyon and the escarpment of tilted rock forming Echo Cliffs. On the east, Reservoir Canyon marks the border of unreclaimed desert. At the north, beginning at the edge of the cultivated fields, the wind has undisputed control. The Oasis and adjoining areas have an elevation of about 5,000 feet, and aside from Reservoir Canyon the topography consists essentially of two classes of features: fantastically carved buttes, tables, needles, and bobbins of bare rock, and dunes of varied expression. The rocks are red and greenish-white in tone, the dunes are yellow-gray, and the landscape presents a strikingly different aspect with each stage of the sun's daily advance and with the passing of infrequent clouds. Moenkopi Canyon, on the south edge of the Oasis, is a nearly vertical-walled watercourse cut 200 feet in brilliantly colored strata. Along its butte-dotted floor, one-half mile in width, the Moenkopi has intrenched itself in an arroyo of alluvium 10–30 feet in depth. Reservoir Canyon likewise is bordered by sheer walls, in places overhanging, of massive, bright-red sandstone. Its wide floor, watered by numerous springs and hemmed in by continuous walls exceeding 100 feet in height, constitutes an ideal natural pasture. Tributary to Moenkopi and Reservoir canyons are many short, bare-floored arroyos which provide an escape for the storm waters falling within a few hundred feet of the larger canyons. On the Oasis as a whole, however, and within the surrounding desert, stream channels are not continuous and the run-off from the southern half of Kaibito Plateau is negligible. The water which falls is absorbed by the thirsty sand and rock or quickly returns to the air. Typical views of the desert border of the Oasis are shown in Plates I*b*, II*a*, and II*b*, which may be compared with Plate III*a*.

CLIMATE.—The climate of the Tuba Oasis is local; topography and elevation are the controlling factors. The keynote of the climate is variability. Canyon and adjoining mesa and even opposite canyon walls have dissimilar climates. The summers are hot, the winters are cold; daylight is synonymous with heat, and darkness with chilliness. Annual, seasonal, monthly, and daily rainfall, temperature, and wind are subject to wide variations.

Miscellaneous precipitation records have been kept by volunteer observers at Tuba for thirteen years (1897–1913), including seven complete years, 1899, 1906, and 1909–13. While not adequate for comparative climatic studies, these records are sufficient to indicate the general features

of the rainfall. The mean annual precipitation for the five years 1909–13 was 7.08 inches. The mean obtained from the average of all months for which records are available is 5.30 inches. This latter figure is believed to be more representative, since it takes into account a series of unusually dry years not represented in the period 1909–13. In any event the value for mean annual precipitation, when it falls to such low figures, has little geographic significance. Annual and seasonal distribution of rainfall are, however, matters of fundamental importance in the life of a desert people. In 1899, 8.38 inches of rain were recorded at Tuba, while 1900, for which six months' figures are lacking, is known as "the year of the great drought." In 1901, with one normally dry month (April) lacking, the rainfall was 2.60 inches, and it is probable that the total precipitation for the four years 1900–03 was little in excess of that received in 1899. On the other hand, 12.57 inches of rain fell during 1906. In a region where the maximum precipitation is insufficient for agriculture and in places even for grazing, these great variations from year to year are matters of economic concern.

Of more direct interest to the native farmer and stockman is the amount of rain received in corresponding months from year to year. During the thirteen years under observation, precipitation has varied widely, and every month except March, July, August, and October has experienced the absence of perceptible rain. The figures, in inches, are as follows: January, 0 to 2.00; February, "trace" to 2.03; March, 0.16 to 1.59; April, 0 to 2.58; May, 0 to 0.75; June, 0 to 0.75; July, 0.19 to 1.90; August, 0.09 to 1.66; September, 0 to 1.98; October, 0.15 to 1.84; November, 0 to 2.92; December, 0 to 1.77. May, with an average of 0.11 inch of rain, is the driest month, and November, with 0.58 inch, the wettest. Winter, with a precipitation of 1.57 inches, is the rainy season. The figure for the fall months is 1.49 inches; for summer, 1.28 inches; and for spring, 0.96 inch. A more significant grouping of months for this area is a "rainy" season, including October, November, and December, during which time 1.70 inches, or 32 per cent, of the rain falls; a dry season, April, May, and June, with 0.66 inch, or 12 per cent; and two intermediate seasons, January, February, and March, and July, August, and September, which record respectively 1.49 and 1.45 inches. May and June combined average 0.29 inch per year. The significance of these figures lies in the fact that April, May, and June are the growing months for most field and forage crops in the temperate zone, and that May and June are the months usually relied upon to produce a vigorous growth. These three months combined received at Tuba less than 0.5 inch of rain for five out of fourteen years, and only once in fourteen years did May receive more than 0.34 inch. Moreover, plants receive only a portion of this meager supply, for evaporation is most effective during the dry, hot, clear days of early summer. The specialized native plants and the selected varieties of native corn make free use of the water stored in the ground by the winter

rains and snows, which, supplemented by the occasional showers of spring, is in normal years adequate to permit seeds to germinate and to send their shoots above ground. The precipitation during winter and spring is not, however, sufficient to bring a crop to maturity. The rainfall of July therefore becomes the critical climatic factor. With July rains, corn succeeds without irrigation on the Navajo Reservation; without them, the crop is a failure. For eleven out of thirteen years the precipitation at Tuba during July, following a greatly deficient rainfall in May and June, was less than 1 inch. During five of these years less than one-half inch fell. Under such conditions the raising of corn and forage crops without irrigation on the Tuba Oasis is doomed to failure, except in highly abnormal seasons.

The typical rainstorm of the Tuba Oasis is one poorly adapted to assist in raising crops. Gentle showers continuing throughout a day are of very rare occurrence. The supply is normally furnished by thunder showers of extreme violence lasting less than an hour. In a number of instances the total precipitation of a month has come from a single shower; e.g., the April rain for 1913, 0.12 inch, fell on April 2. The area wet by showers is usually a few square miles and not infrequently only a few hundred acres. Immediately before and soon after these showers bright skies and high temperatures are in evidence, and the ground and clothing are dried so quickly that a tent, even during the rainy season, was found to be superfluous baggage.

Heavy thunder storms may occur at heights of 2,000 to 5,000 feet without wetting the ground, and on one occasion the only result of a severe upper-air storm was the falling of a few dozen hailstones. Lightning is an almost invariable accompaniment of showers; scarred trees accordingly are familiar sights on the higher parts of the Western Navajo Reservation, and this area is included in the region of maximum damage by lightning, as determined by the Bureau of Forestry. On two occasions my camp equipage was struck by bolts. The Navajo has good reason for his belief in the vindictive power of the "lightning people."

The mean annual temperature at Tuba is 52°.1. The mean of the warmest month, July, is 77°, and of the coldest month, December, 30°.5. The mean monthly temperatures of spring, summer, and fall show moderate differences from year to year, but December and January exhibit substantial variations. Thus, the December mean for 1898 was 23°.7; in the following year, 38°.7. In 1898 the January mean was 23°.2, replaced in 1900 by a mean of 43°.2. Temperatures above 100° are rare, being recorded on two occasions only during the three years 1910–12. During the same period, Holbrook, in the Little Colorado Valley, 100 miles south of Tuba, recorded 35 such days, and Hite, in the Colorado Valley, 110 miles north, had 101 days with temperatures exceeding 100°. Extremely low temperatures likewise are not characteristic of Tuba's climate. The thermometer recorded 73 days with temperatures of 15° or below for the three-year

period 1910–12, and four days with temperatures below 0°, viz., November 3, December 26, January 27, and February 6. The lowest temperature recorded is −13° and the highest 108°, giving an absolute range of 121°. Snow falls in normal years during one or all of the winter months, and attains an average annual depth of about 6 inches. The average dates of killing frosts are May 13 and September 23, thus giving a growing season of 133 days, ample for grains and most fruits. In exceptional years frost has come as late as June 5, and has killed plants as early as September 19.

As in most other arid regions, the heat of the day begins abruptly with the rising of the sun and continues to sunset. During the middle of the day instruments and camp utensils, as well as rocks exposed to the sun, may not be touched without pain. The great heat and the high daily range fortunately are accompanied by low humidity. The records at Flagstaff, 80 miles southwest, give a mean relative humidity for the year of 62 per cent, dropping to 39 per cent in June. This station receives 81 per cent of the possible amount of sunshine. The Oasis of Tuba is less humid than Flagstaff, and on the average has probably 250 clear days during the year. Sunlight is associated with heat and shade with cold, and the boundary between areas of unlike temperatures is sharply drawn at the edge of a shadow.

Soil.—The local soil of the Tuba Oasis is weathered from lime-cemented quartz sandstone including lenses of limestone, and to it is added dust carried by the wind from the argillaceous, calcareous, and volcanic rocks of the Little Colorado Valley. The oriignal organic constituents of the soil are supplied by roots and branches of semi-desert flora, buried each season by wind deposits. The alkali present, though not large in amount, is sufficient to demand care in the selection and cultivation of crops.

Flora.—The climate of the Tuba Oasis is unfavorable for the growth of plants, except those adjusted to arid conditions. At springs and on the damp floors of canyons, tules and water-loving grasses and herbs maintain a vigorous growth. A few feet from water-soaked soil low, wide-spaced individuals or small groups of greasewood, sage, rabbit brush, yucca, and cactus form the vegetal cover. Goldenrod and other Compositae find a foothold in favored localities. Following rains, diminutive, short-lived, but brilliantly flowering plants of several species form pleasing bits of color. A few weatherbeaten cottonwoods at Moa Ave and on the floor of the Moenkopi Canyon, and a grove of small, scattered cedars four miles north of Tuba included all the trees near the Oasis at the time of the Mormon occupation in 1878. The nearest piñons were 15 to 20 miles distant, and yellow pine, suitable for timber, was brought from the San Francisco Mountains or the north rim of the Black Mesa across fifty miles of desert.[1]

[1] This information was kindly furnished by A. B. Randall, of St. Joseph, Arizona, a member of the Mormon pioneer band.

Hough has shown[1] that the Hopis and their ancestors, the cliff people, were wonderfully adjusted to their plant environment. Of about 150 indigenous species, 144, including certain duplicates, were used for food, architecture, medicine, dress, or in religious ceremonies. Almost every plant is used in some way by the Hopis, and there is none for which they have no name. For these people, who are capable of running 100 miles without stops, it is a matter of small moment that pine boughs must be brought from the San Francisco Mountains, wild tobacco and flax from the Little Colorado, and wild berries from the highlands along the San Juan. Of 40 plants used as food, including roots, stems, leaves, and seed, the highly specialized Hopi corn takes first rank. In fact, the culture of the Kisani race, to use the convenient Navajo term for the Hopis and their ancestors, may be said to be based on the corn plant. For purposes of dress and adornment six species of plants were considered suitable. That two of them, yucca and cotton, were long in common use is attested abundantly by seeds, stalks, and fragments of cloth found in ancient ruins. The cotton of the Tuba Oasis (*Gossypium Hopi* Lewton) is a distinct species as respects structure and manner of growth.[2] It ripens earlier than other known species, a feature which has permitted adjustment to the inhospitable climate of the Navajo country.

Owing to the industry and foresight of the Mormon colonists, the government farms and gardens on the Oasis of Tuba furnish an unusually large variety of fruits, vegetables, and field crops. Like true agriculturists, the Hopi Indians at Moenkopi have tried out seeds obtained from the Spaniards and later explorers until their fields include upward of 25 kinds of cultivated plants utilized as food and medicine.

FAUNA.—The area adjoining the Oasis of Tuba is the home of reptiles and rodents. Snakes are common and lizards occur in abundance. During the course of a day's field work, on several occasions, more than 100 brightly colored lizards have been noted scurrying across sand dunes and bare rock or partially concealed among sage and greasewood. Field mice and field rats make their nests at the base of scattered clumps of brush and in crevices of rock; and prairie dogs are found along the floor of the larger washes. During some years rabbits overrun the country; at other times they are rarely seen. Of beasts of prey the coyote is the most troublesome, and the shepherds must be on guard constantly against the raids of these skilful marauders. In addition to rabbits, prairie dogs, and wild fowl, the ancient and modern Indians made large use of the antelope, which until about 1880 grazed on the grasslands and utilized the waterholes in the region between the Little Colorado and the San Juan. Judging from the traditions of Hopi and Navajo, hunting and trapping the antelope must

[1] Hough, Walter: "The Hopi in Relation to Their Plant Environment," *American Anthropologist*, X (1897), 33–34.

[2] Lewton: "The Cotton of the Hopi Indians," *Smithsonian Misc. Coll.*, LX (1912), No. 6, 1–10.

have engaged the energies of plateau Indians, at certain seasons, for many centuries. The introduction of sheep and goats has relieved the Indian of much anxiety regarding his meat supply; and the eating of reptiles and insects, the resort in times of famine, now is practiced rarely.

WATER SUPPLY.—Absorption of the rainfall on the Kaibito Plateau is favored by porous rock and wind-blown soil, while the arrangement of strata is favorable for the retention of water at a horizon within 100 feet of the surface. In places this water table has been brought near the surface and even exposed by dissection, producing groups of springs to which the Oasis of Tuba owes its existence. With the exception of the springs and of the water made available by recent trenching of the alluvial fill in Moenkopi Canyon, no permanent supplies of water for irrigation or for domestic use are found within a radius of 25 miles from Tuba.

The location of springs and the geologic conditions which determine their presence in the Tuba region are shown diagrammatically in Fig. 2. The springs issue from joints in the sandstone and from the contact of

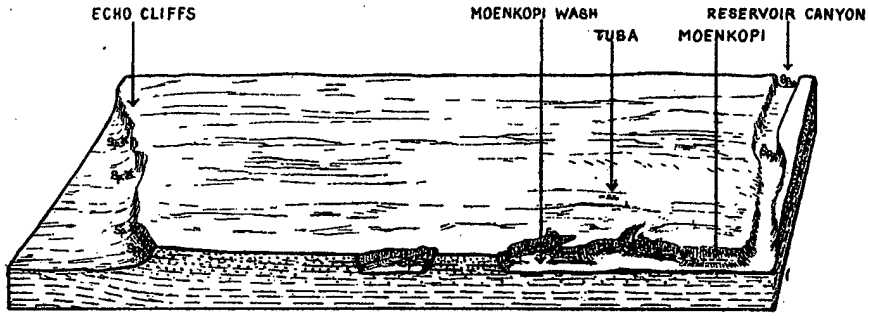

FIG. 2.—Diagram illustrating the conditions controlling the emergence of ground water on the Tuba Oasis. The front of the section is the north wall of Moenkopi Canyon.

massive, porous, cross-bedded sandstone with underlying thin-bedded sandstone and shale. The water is brought to the surface by two processes: exposing the water-bearing horizon by the cutting of canyons, and reducing the thickness of the upper bed by weathering and eolian abrasion. Thus the interesting phenomenon is presented of increase in available water supply without increase or even with possible decrease in amount of precipitation. Before the cutting of Reservoir and Moenkopi canyons the springs now issuing from their walls were represented by others which emerged far to the west in cliffs facing the Little Colorado. Also, during the time that the sandstone forming the floor of the plateau retained its normal thickness of several hundred feet it is unlikely that ground-water would have found its way to the surface near the site of the Tuba school. At the present time the sandstone has been eroded to such a degree in certain places that the water-bearing beds are within the reach of shallow wells. I am informed that in selected localities the Mormon colonists were accustomed to provide water for stock by blasting shallow holes in

dry, windswept rock. On the other hand, a shaft sunk to a depth of 212 feet at the copper mines, 35 miles north of Tuba, failed to recover water.

The changed habit of the ephemeral streams of the Tuba region has resulted also in increasing the amount and permanency of the water supply. Since about 1885 the Moenkopi and its tributaries have trenched their alluvial floors to depths of 15 to 30 feet, in many places exposing bedrock. By this process the amount of water in Moenkopi Creek at Tuba is said to have increased 600 to 800 per cent between 1878 and 1903.

Another interesting feature of the water supply of the Oasis is the burial of springs and spring-fed rivulets by drifting sand. More than a mile of Reservoir Canyon has been obliterated by traveling dunes, and the visible springs and seeps gradually are lessening in number (Plates III*b* and I*b*).

Without irrigation, agriculture is possible only in the immediate vicinity of springs, and the habitability of the Oasis is maintained by diversion of water at the springs and by extending ditches from the Moenkopi.

THE HUMAN POPULATION.—*The first settlers.*—The Oasis of Tuba, with its water and tillable land and its protective zone of surrounding desert, afforded a favorable site for settlement by a band of peaceful, agricultural Indians. Ruins near Tuba, at Honogee (Plate II*b*), and the mass of débris over which the present Hopi village of Moenkopi is built, indicate a very ancient occupation. Doubtless the Oasis was utilized for permanent settlement or as an outpost for villages at Tusayan or on the Little Colorado at Black Falls at a period long antedating the Spanish invasion. That the place was insignificant as compared with the more prosperous Kisani pueblos of the sixteenth century is suggested by the derisive term "Rancheria de los Gandules," applied by Oñate in 1604.[1] Whatever the date of the first settlement, the ruined buildings and abandoned fields, as well as the tribal traditions, indicate that the ancient inhabitants of the Oasis were ancestors in direct line of the present Hopi farmers.

Coming of the Piute and Navajo.—The Oasis of Tuba with the near-by springs at the base of Echo Cliffs affords the only reliable supply of palatable water over a vast expanse of desert south and east of the Colorado canyons and the only place where corn may be raised with comparative ease. It has served, therefore, as a station on routes across the Plateau Province (Fig. 1) since the days of the earliest inhabitants. Trading and foraging expeditions from the Havasupai and Walapai settlements on the lower Colorado, hunting parties of Piute and Navajo from north of the Colorado canyons, Spanish explorers, Mormon emigrants, and government scientific expeditions have utilized the Tuba route. To the roving bands of Piutes the Oasis was particularly attractive, and as their strength increased raids were made more and more frequently on the fields and homes of the Hopi. Following the Piutes came the Navajos, who on account of superior horsemanship and skill in warfare dispossessed Piute

[1] *Colección de Documentos Quéditos*, XVI (1871), 276.

and Hopi alike and rendered the Tuba Oasis no longer continuously tenable by an agricultural people. From the middle of the eighteenth century to the date of the Mormon colonization the fields at Moenkopi were cultivated intermittently by farmers who made their homes in the well-protected village of Oraibi, 40 miles distant. Garces, in 1776, found on the Oasis a "half-ruined pueblo . . . . which had been a pueblo of the Moquis, and that some crops which were near to a spring of water were theirs, they coming to cultivate them from the same Moqui pueblo [Oraibi] which is so large."[1] Judging from traditions, a few Hopi men, reluctant to abandon their excellent and much-needed fields, remained for a year or two at a time, and a few Navajos appear to have planted cornfields from time to time. Life under these conditions was precarious and attempts at agriculture most discouraging, and it occasions no surprise to learn that Jacob Hamlin, in 1874, found at Moenkopi "only one Piute family and an Oraibi woman."[2] An interesting side light is thrown on this distressing period in the history of Tuba by the fact that the Pakab (Reed) Clan of Moenkopi includes the chief of the Hopi Warrior Society.

The Mormon occupation.—Missionary enterprises of the Latter Day Saints led to a series of expeditions south of the Colorado Canyon. Between 1858 and 1871 Jacob Hamlin, with a few companions, conducted seven excursions to Oraibi, crossing the Colorado at "The Crossing of the Fathers," Pierce Ferry, and Lee's Ferry. During the course of these expeditions much information had been obtained regarding the Tuba Oasis and the Little Colorado Valley, and on the basis of favorable reports the "saints were called to settle in Arizona." Disastrous experiences in the Painted Desert forced the return to Utah of the large group of emigrants who crossed the Colorado in 1873; the one family left at Moenkopi in that year was forced by the Navajos to leave in 1875. Settlement by a few families was effected in 1876, and two years later occupation of the Oasis was placed on a permanent basis (Plate IV*a*). At first the abandoned fields in Moenkopi Wash were cultivated; later, fields were prepared near the springs on the upland, and Reservoir Canyon and Moa Ave were brought under cultivation. Corn, wheat, and garden crops were harvested and a few years later fruit and the flesh of cattle and sheep were added to the food supply. The conditions of life for the Mormons were hard, for, in spite of its fertility, the Oasis is small and the white population never exceeded twenty-five families.[3] Previous to the construction of the Santa Fe line (in 1883), which brought the Oasis within 80 miles of a railroad, supplies had to be brought over the long trail from Salt Lake City, 450 miles distant, or carried by wagons over the 370-mile stretch of difficult road leading from Albuquerque. Only light loads could be

[1] Translation from Coues, Elliott: *On the Trail of a Spanish Pioneer*, II, 358.

[2] Little, Joseph: "Jacob Hamlin," *The Deseret News*, Salt Lake City, 1909.

[3] Personal communication from the historian of the Latter Day Saints, 1914.

carried, and a round trip occupied from two to four months. Little fuel except brush was at hand and the nearest timber for building was found at the San Francisco Mountains, 50 to 60 miles distant across the treacherous Little Colorado. The climate, at all times inhospitable, was particularly unfavorable during the period 1898–1903. The year 1900 is known as the "famine year." No water flowed in the Moenkopi; the smaller springs dried up; and the flow of water from the big springs at Tuba was too meager for irrigation. No grass grew on the plains or in the washes; cedar and piñon died on the ridges. Sheep and horses perished for want of forage. The Navajos were reduced to a diet of bark and horse meat, and the Mormons faced starvation. The struggle of the pioneers for a livelihood was made more difficult by the continued hostility of the Navajos. Stock was killed or stampeded; fields were overrun by horsemen; irrigation ditches were broken and several white men were killed. By a process of "following and pacifying," combined with judicious trading and diplomacy, friendly relations were established, and certain well-disposed Navajos and Piutes were permitted to establish themselves on the borders of the Oasis.

To the Hopis the coming of the white man was welcome. Under the protection of a stronger race, the farms of their ancestors, practically abandoned for 250 years, were reoccupied. In 1880 Tuba (after whom the Oasis is named) and his family appear to have been the only Hopis residing at Moenkopi throughout the year. Gradually more families came in, many of them returning to Oraibi each year after the crop was harvested, and by 1903 probably 100 people of the Hopi race had made their permanent home on the Oasis, planting their corn and caring for sheep.[1]

Occupation by government officials.—Following disputes over land titles the Oasis of Tuba came under government control in 1903. In legal phrase it was "purchased" for $45,000, and the Indian Office took possession of the only spot within an area of 7,000 square miles suitable for an administrative center. The Mormon pioneers, removing to St. Joseph and other points in the upper Little Colorado Valley, took up anew their accustomed task of reclaiming the desert, and the burden of caring for the fields at Tuba fell to the lot of civil-service employees. From the standpoint of agriculture the change in ownership has resulted in loss. The necessity of obtaining an adequate food supply from a small acreage led to a high grade of intensive cultivation on the part of the Mormon colonists; government officials are, however, under no obligation to support themselves from the yield of local fields, and if occasion demanded it all food for man and beast could be obtained from outside sources. The government at Tuba is a dispenser of charity rather than a commercial enterprise, and agriculture is practiced for the benefit of the Indians, not as a means of self-support.

[1] I am indebted to Mr. Walter Runke, superintendent of the Western Navajo Reservation, for this recent Hopi history, obtained from Pole-Hongevi, grandson of Tuba.

On this basis the plans for constructing reservoirs and for recovering the flow of the Moenkopi merit approval in spite of the many unsuccessful experiments and of a cost not justified from a commercial standpoint. The conditions warrant the reclamation and enlargement of the fields formerly cultivated by the Hopis and Mormons. As shown on the map (Fig. 3) about 40 acres of land on the school grounds at Tuba are irrigated by three springs which have a combined daily flow (1908) of 116,329 gallons, or about 0.50 acre-feet. At an estimated cost of $13,500 the

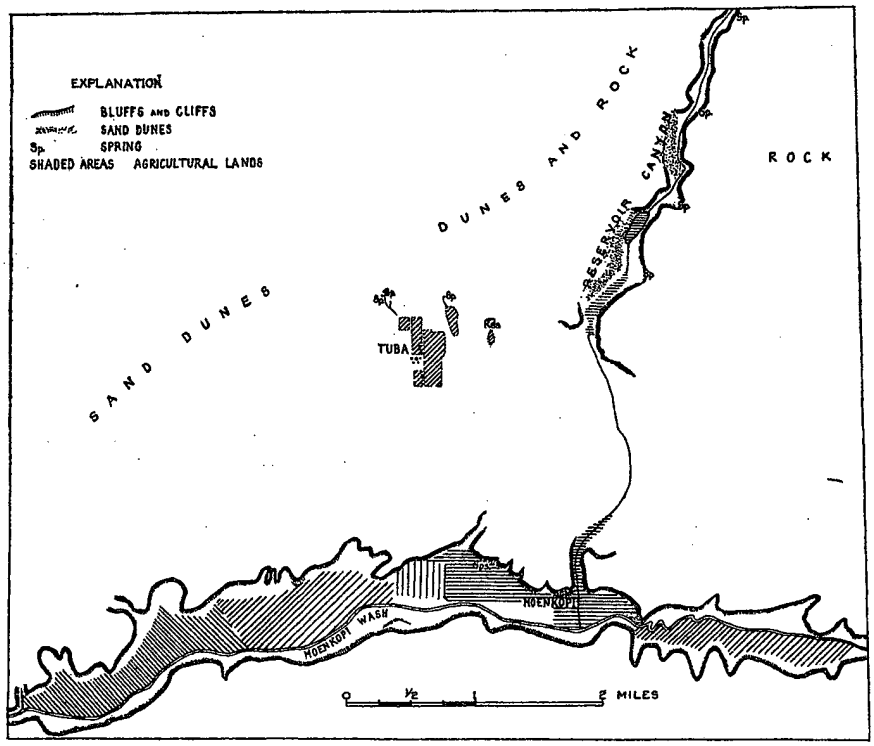

FIG. 3.—Map showing distribution of agricultural land on Tuba Oasis with reference to water supply.

supply of water could be made more certain and the tillable acreage somewhat increased.[1] Reservoir Canyon affords admirable pasturage, but is not suitable for farming. The flow from the Moenkopi, combined with that from Reservoir Canyon and the surplus from springs in the canyon wall, is capable of watering about 1,000 acres on the floor of Moenkopi Wash. On these irrigated lands, corn, wheat, and alfalfa produce large yields; vegetables of all sorts are readily grown, and fruit culture yields surprisingly large returns. Tuba apples are famous.

[1] Figures obtained from an unpublished report by Rollin Ritter, on file in the Office of Indian Affairs, Washington.

Agriculture, however, is a minor part of the duty of the government officials. Tuba is essentially a school with indoor and outdoor teachers. The children of Navajos and Piutes are brought in from the traveling camps of their parents, housed, fed, clothed, and taught. The stockman teaches the Indian better methods for increasing, improving, and caring for sheep and cattle; the farmer teaches the Indian while employing him in the planting and care of crops. The physician teaches sanitation and points the way of escape from the dreaded prevalent diseases, tuberculosis and trachoma. The task of the missionary is peculiarly difficult and, like those of his predecessors, the Spanish priests, his efforts so far have yielded small returns.

Under the protection of the government the Hopi population at Tuba has increased by migration from less favored localities until in 1914, 210 to 225 members of this tribe made their home on the Oasis. In addition to these permanent settlers many of their relatives reside at Moenkopi during the growing season. I am informed by Superintendent Runke that each marriage of a Moenkopi resident with man or woman from the Tusayan villages usually results in the founding of a new home on the Tuba Oasis. Like their ancestors of the Kisani race, the present Hopi are skilful agriculturists and the only important change in their life during the past centuries has been the substitution of mutton for the flesh of wild animals. They retain the ancient type of dwelling, conduct their time-honored ceremonies, and closely follow the traditions of their ancestors. Like the Hopis of the Tusayan province, the inhabitants of the Moenkopi village are clannish, independent, and desire to be let alone. The efforts of missionaries are particularly annoying to them. They ask nothing of the government except protection from the Navajo raiders and an occasional opportunity for remunerative employment. With their excellent fields of corn, wheat, melons, squashes, and fruit, and their carefully tended flocks, the Hopis of the Tuba Oasis are essentially self-supporting (Plates IV*b* and V).

The 6,000 Navajos and 200 Piutes under the Tuba jurisdiction have undergone little change as the result of enforced contact with the whites. About 200 of them haltingly speak the English language and wear modern attire. A few Navajos have farms on the Oasis; the others, continuing to lead their nomadic lives, come to the agency only for purposes of trade or for temporary employment.

Tuba is an attractive spot. Contrasts of desert and oasis are in few places better displayed. As a center for the study of the adjustment of unlike races to changing conditions of physical and human environment, it offers an unusual opportunity for detailed geographic research.

Explanation of Plate I

a. View in the Painted Desert, which forms a belt extending from the western border of Tuba Oasis to the Little Colorado Canyon. Its surface is formed of intricately carved and brilliantly colored rocks interspersed with areas of sand.

b. Traveling dunes near Reservoir Canyon.

PLATE I

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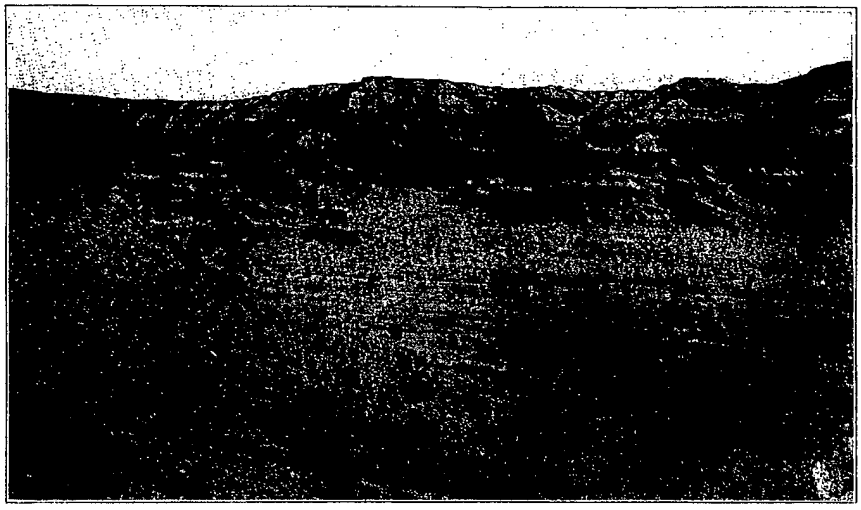
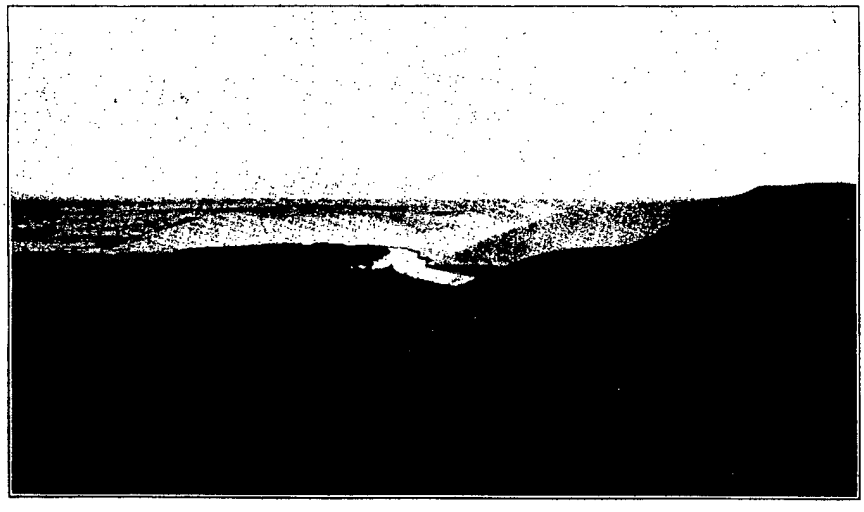


a



b

Explanation of Plate II

a. Wind-swept rocks along the northern border of Tuba Oasis.

b. Bare canyon wall with ancient cliff house at Honogee. (Photograph by Walter Runke.)

Plate II

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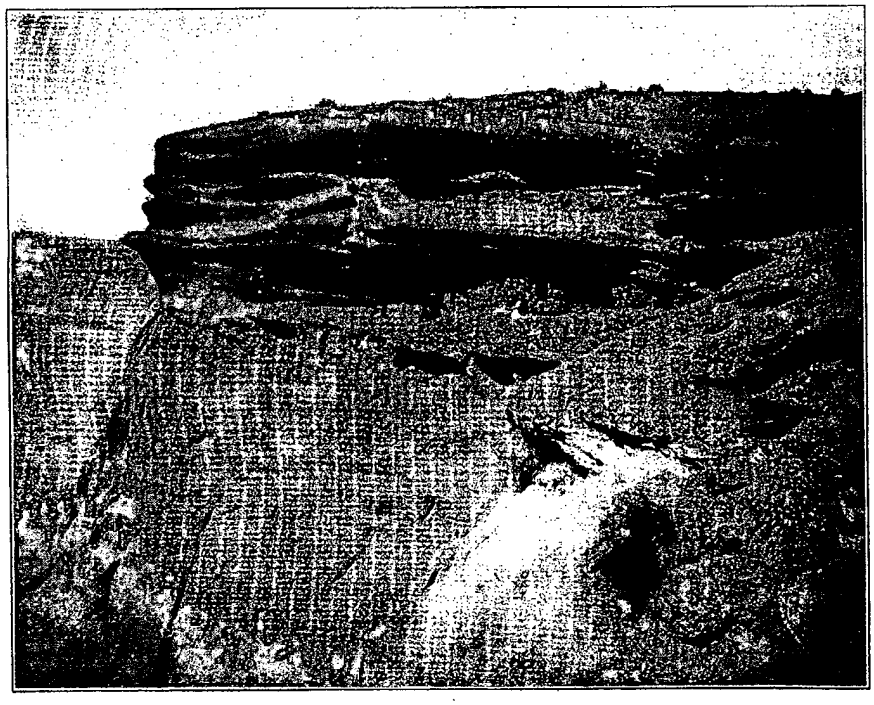
a



b

Explanation of Plate III

a. View on the Tuba Oasis.

b. A portion of a canyon on Kaibito Plateau filled by wind-blown sand.

PLATE III

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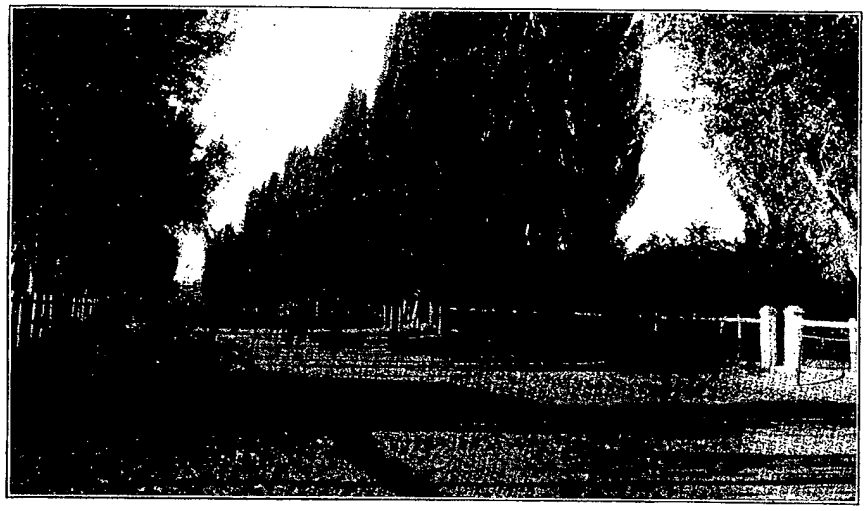

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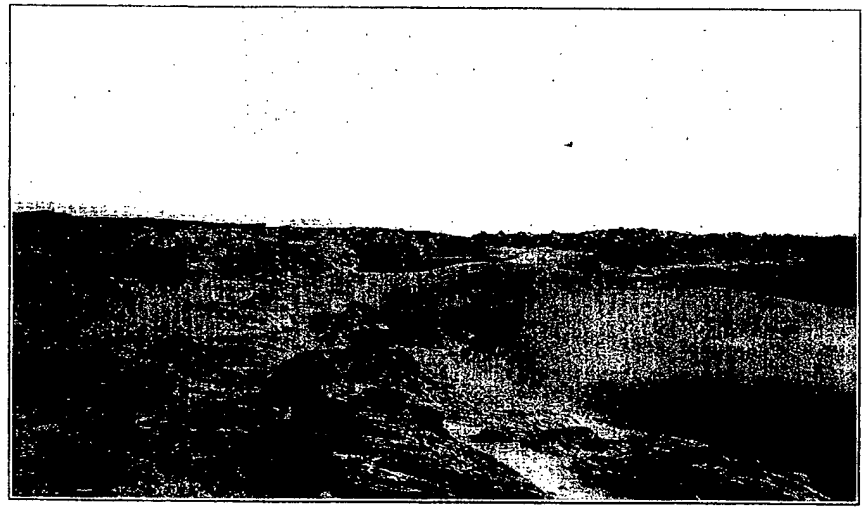

b

Explanation of Plate IV

a. Fields in Moenkopi Wash reclaimed and cultivated by the Mormons.

b. Hopi cornfield at Moenkopi.

PLATE IV

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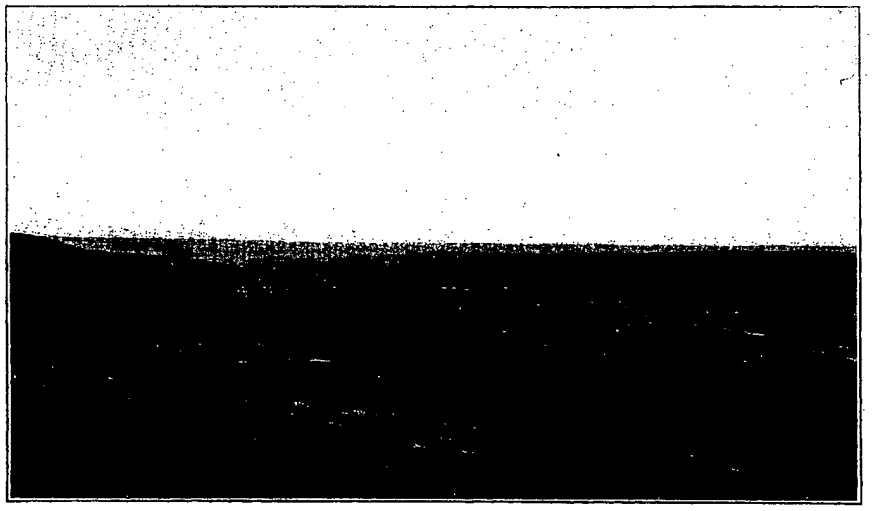

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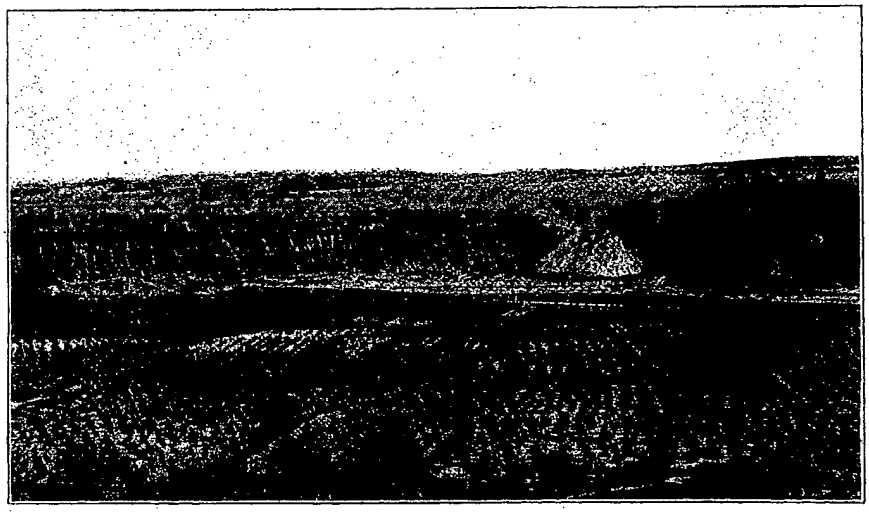

b

Explanation of Plate V

The Hopi Village of Moenkopi, built since about 1880 on the site of an ancient pueblo.

Plate V

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